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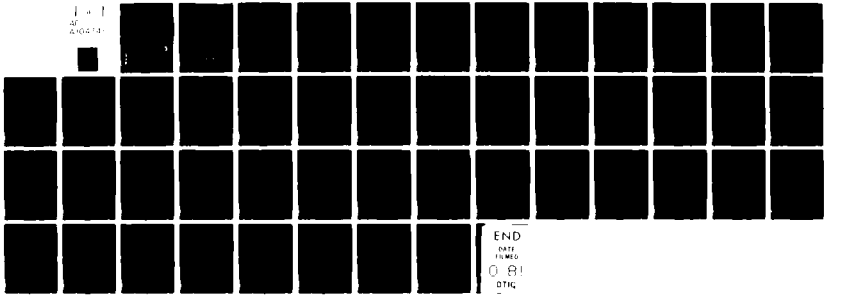

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MAGNETOGRAM PROCESSING

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Magnetogram, data processing overlay structure.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is a users guide to the Magnetogram Data Processing System as implemented at the AFGL CDC 6600 installation.

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CONTENTS

MAGNETOGRAM PROCESSING

0. Introduction

The magnetogram data were collected at seven stations, transmitted to the Air Force Geophysical Laboratory, and stored on magnetic tape. The data from one station consists of readings of the magnetic field of the earth, the rate of change of the field, and some engineering data. This data is collected, packed, and stored for 10 second intervals at each site. The packed data is transmitted in ten second blocks from the station to AFGL. A dedicated mini-computer reorganizes the data and stores it on magnetic tapes. These tapes form the data base.

The stations are listed in Table 1. More detailed information on the magnetometer data network may be found in D.J. Knecht, R.O. Hutchinson, and C.W. Tsacoyeanes, AN INTRODUCTION TO THE AFGL MAGNETOMETER NETWORK, Air Force Geophysics Laboratory, April, 1979. (Unpublished).

The main ideas governing the construction of a routine to read this data base and of a main program to analyze and display the data are given in section 1. Section 2 covers aspects of the analysis program as well as detailed descriptions of the data bases used or created; in particular the structure of the main data base is given in section 2.1.1. Particulars of the use of the program are in section 3.

1. Basic Concepts

1.1 Data Accessing Routine

Since a large data base is being created, a standard routine was envisaged to access any point of the data. This would eliminate any redundant efforts needed to access separate parts of the data in separate analyses. However, detailed consideration was necessary to provide a subroutine which would be easily usable in applications.

The data are read from file MSDATA by function MGREAD, (MSINN, ID, IDATA, NDATA, NSTA). MSINN is the earliest acceptable time in milliseconds since 1970. If positive, the next satisfactory data set is provided. If MSINN is -1, the last data set which was extracted is reused. If a millisecond count is set negative, then only that number of milliseconds or the closest time after that specified is acceptable. If only a particular station is wanted, the negative of the station number is entered in NSTA; positive values are not checked.

The data set is specified by MSINN and possibly NSTA. ID indicates which data are to be extracted from the set.

Of the two decimal digits of ID, the first specifies the type of data, the second subdivides the type. The possibilities are listed in table 1.2. The values 34 and 14 give the vector values of the magnetic field each second and the change in the magnetic field each .2 seconds.

Additional controls are provided through commons. In particular, /MGREDC/ and /STANUM/ provide switches for optional handling of bad data; /MGDIMF/ indicates the present location on the tape and control restarting; /MGDATC/ control the unit read.

1.2 Program Requirements

The general requirements defining the main program were flexibility in use, the possibility of expansion and modification and the capability to be used in either batch mode or interactively.

Flexibility can be obtained through a modular structure where each input card specifies a module to be executed. This allows modules to be added or modified individually and puts the ordering of modular operations under control of the input deck. For ease in interactive use and in batch, the input is free form with a keyword being a mnemonic for the operation to

be done. The interactive use restricts the size of the allowed program requiring an overlay structure. The main overlay was to be as small as possible with a higher overlay to interpret the keyword cards and to control the main overlay. This allows the other overlays to be treated as modules. The separate overlays act as individual programs except that certain data can be passed between them or saved and reused and that they can link to each other without requiring another keyword card.

	Location Geographical N Lat	W Long	Magnetic N Lat	E Long	Initial	Dials	Std Index	Data Transmission Index
	48.3	117.1	55.2	299.6	NEW, WA	WA	1	1
	44.2	103.1	54.1	317.3	RPC, SD	SD	2	3
	44.0	90.3	56.3	334.2	CDS, WI	WI	3	5
	42.6	82.9	55.8	344.8	MCL, MI	MI	4	7
	42.2	71.3	55.8	1.9	SUB, MA	MA	5	9
	17.8	82.5	40.7	344.9	TPA, FL	FL	6	8
∞	34.7	120.6	40.2	300.6	LOC, CA	CA	7	2

MAGNETOMETER STATIONS

Table 1.1

ID Value		Data Item Every sec.	Total Number of Values
11	x component search coil	.2	50
12	y component search coil	.2	50
13	z component search coil	.2	50
14	Full vector search coil	.2	150
21	x component Fine Flux	1	10
22	y component Fine Flux	1	10
23	z component Fine Flux	1	10
24	Full Vector Fine Flux	1	30
31	x component Total Flux	1	10
32	y component Total Flux	1	10
33	z component Total Flux	1	10
34	Full Vector Total Flux	1	10
41	x component Coarse Flux	5	3
42	y component Coarse Flux	5	3
43	z component Coarse Flux	5	3
44	Full Vector Coarse Flux	5	9
51	Additional Data	10	13
52	Analog Engineering Data	10	23
54	Digital Engineering Data	10	15

DATA TO BE EXTRACTED

Table 1.2

2. Structures

The main structures are given in this section

2.1 Data Structures

2.1.1 Magnetogram Data Tapes

The standard file name for these is MGDATA. The tapes are 7 track, 800 b.p.i. A short description of the format is given below; for a complete description, see D.J. Knecht, Archive Data Tapes of the AFGL Magnetometer Network, Air Force Geophysical Laboratory, to be printed (Unpublished).

The data are packed into 12 bit quantities, which will be called slots to avoid conceptual problems with 16 and/or 12 bit words. The slots are grouped into sets; the sets in turn are grouped into records.

The data stored are signed integers in 2's compliment form. A slot may contain a single 11-bit integer, sign and 10-bit magnitude, plus a flag in the low order bit, which is set if the data is suspect. The initial slots in a set which contain information pertinent to accessing the data, are 12-bit signed integers; i.e. they do not have a flag as the low order bit. However, a string of data may be compressed into an initial value, a string of deltas (change from the present value to the next), and the final value. The compression results from the restriction of the deltas to 6,4,3,2, or 1 bit quantities which are packed, the slots giving packing factors of 2,3,4,6, and 12. The shortened deltas are packed from low order to high, which is opposite many conventions. The first delta is inaccurate. To reconstruct the data the deltas must be used in reverse order to produce the data from the next to the last value to the second. In the case of a value remaining constant, no deltas are stored and only one value is stored.

Some slots may contain strings of one-bit flags. In this case the packing is from high order to low.

The first three slots of a data set define the type of data set, the subtype of data set, and the total number of slots comprising the data set.

A data set has two different formats depending on whether packing was used. The ordering of the data is described in Table 2.1. The fourth word is set to 1 if packing was used and to -1 if it was not. The two columns of slot numbers in Table 2.1 indicate which slots contain the information needed to access the data in these two cases. Brackets [], indicate data which might be packed. Vector data is given in three arrays: all x data first, then y, then z. X is north, y is east, and z is down.

Since the records have a maximum length of 2560 slots and the sets of slots have a variable length, a daya type of -1 terminates the record. There may be slots filled with garbage after the -1 data type but no data should follow until the next record.

The tape ends with a double end of file, a single end of file, or the physical end of the tape. Since some tapes have been restarted, an end of file may be followed by subsequent data.

In addition to the transmission errors which are detected and either corrected or flagged, errors of various types evidence themselves in the time parameter; among these are: erroneous time, data apparently out of chronological sequence, and subsequent data overwriting the start of the data tape.

TABLE 2.1 DATA FORMATS

Packing Used Slot	No Packing Slot	Quantity	
1	1	1 (type)	
2	2	0 (subtype)	
3	3	Number of slots	
4	4	Packing flag: 1 = packing -1 = no packing	
5,6,7	/	No. of bits/value for Search Coil X,Y,Z	
8,9.10	/	No. of bits/value for Fine Flux X,Y,Z	
11,12	/	No. of bits/value for Analog and Digital data	
13,14	5,6	Time of receipt of data in seconds past 10 second mark and milliseconds	
15	7	Diagnostic check for mini-computer	
16, on	8, on	Actual data:	
		[Search Coil X] [Search Coil Y] [Search Coil Z]	50 values of each Unit=gamma/sec
		[Fine Flux X] [Fine Flux Y] [Fine Flux Z]	10 values of each Unit=gamma/sec
		[Coarse Flux X] [Coarse Flux Y] [Coarse Flux Z]	3 slots for each 2 values, unit = 64 Flag string, align with fine flux value indicating location of change
		[Analog data] [Digital data]	23 values 15 values
		Additional data	13 slots
		1	5 volt values
		2	Temperature of electronics
		3	Temp. of sensor
		4	Station ID number
		5	Serial Number
		6,7	Status words
		8,9,10	Synch words
		11,12,13	Time of data

2.1.2 Averaged General Data File

The file AVGEN is the main file for data use. Overlay (2,0) creates this file from the data tapes. (4,0) transfers data between this type of file and mass storage. (3,0) plots data stored on AVGEN. The file OLDAVG has the same structure.

The first logical record is a character string labeling the file. The first 100 characters contain the date and time which the file was created as a standard file. Subsequent sets of 10 characters contain the date and title of each run which modifies the file. A list of abbreviations of the stations used end the record.

The second logical record consists of data specifying the averaging and packing of the magnetic data held on the file. This consists of copies of the two commons /AVGC/ and /STATC/. Each copy is preceeded by one word giving the length of the common; this allows for future changes without invalidating any earlier files. The data in the commons are described individually in the description of overlay (2,0).

The following logical records consist of as many sets as can fit into LIØB words; LIØB being set to 512. A set consists of a time word and three average data words from each station which is to be included. Thus, if NSTA stations are used, a set has 3* NSTA + 1 words. The time word is an integer giving the average time in milliseconds since 1970. The data words are the average flux with the value of AVGFLG, set to 65536., indicating the lack of data.

The data are in chronological order. The number of points per average is NTAVG and the spacing of averages is MSDAVG; thus the average could contain one point for non-averaging, could overlap for smoothing, or could be widely separated for sampling. The parameters may be changed by input cards.

2.1.3 Mass Storage Data File

The file MSFILE is a random access storage file which allows large amounts of data to be stored and accessed easily. The data must be put into AVGEN form before using but this can be done quickly and without imprinting a tape.

The file is a CDC random access file with a numerical index. The first record is a character string containing the starting and ending date and time, a general label, a list of station initials, and the date, time and title of each run contributing to the file.

The second record contains a copy of common /RAMXS/. The contents are described in detail in the section on overlay (4,0).

The other records contain data. The first word is the time of the first data set. Each record contains data sets each of which has NQSETM items: NDSM items from each of NSTAM stations. The time interval between sets is MSDMS milliseconds. The time of the first data set is given in milliseconds since 1970. If a datum is absent the value FILLMS, set to 65536., is used. Each record contains an interval of MSREC milliseconds and the initial record starts at INTMSM milliseconds since 1970.

2.2 Program Structure

The program was designed in an overlay structure to save space. The main overlay was designed as simply as possible; its sole function is to call higher overlays upon command and pass data. Significant data are passed via commons as are the commands controlling the calling of overlays. A few generally useful subroutes are included which are used by several overlays. One result of this organization is that general data read to control one keyword may be available for others even when different overlays are used.

The program was constructed and checked under a system which kept a record of all modifications. Since this system is of more general use it is described in appendix A.1.

The overlays are described in the following sections. The routines are listed in tables 2.2.nR and the commons in table 2.2.nC where n is the number of the overlay. Similarly, flow charts of the main routines are in figures 2.n.

2.2.1 Overlay (1,0) --- Control

Overlay (1,0) controls the program. Keyword cards are read in and acted upon. For ease in use these are free field cards modeled after CDC job control cards, except that numeric fields may be either integer or real. Keywords which change parameters or do simple tasks are acted upon in this overlay. Those needing magnetogram data request the main overlay to call in the appropriate overlays before returning control to this overlay. In this way, the modular structure of the entire program is maintained; control of the sequence of operations is given to the person running the program through the keyword cards.

2.2.2 Overlay (2,0) Data Base Access

In many ways this overlay does the main task of the program: a data tape is read and a compact data file is created. The data tape, MGDATA, is read by MGREAD as described in section 2.1.1. The data is checked for bad spots while being unpacked and bad data is replaced by 99990. or 99999. (This could be changed through common /MGREDC/). The data times returned are checked if the data are to be used. Times showing jumps greater than 15 seconds are stored until either the time discrepancy resolves itself or the error storage area is filled. In the former case, the times of the saved data is corrected before the data is used; in the latter, the new time is considered correct. Time reversals due to long sections of bad data impede the use of the following data; for this reason MGDATA is not normally rewound before use so that the tape may be positioned externally from the reading routine.

Once a data set is unpacked and checked for problems, especially time discrepancies, and it is from one of the stations and time interval desired, the data is stored by routine STODTA in the buffer IBUF. When this buffer is full, the routine AVGOUT is called to pack the data into the buffer IØB. The data is packed by averaging controlled by two main parameters: NMSAVG and MSDAVG. NMSAVG is the number of milliseconds to be averaged over. MSDAVG is the displacement from one average to the next. NTAVG and NTDAVG are the number of time points in the average and in the displacement assuming MSPT milliseconds per time point. Depending on the relative values of these parameters, the averages may overlap producing smoothing or they may be widely separated for sampling. Averaging over one sample results in direct use of the data. Data which was flagged by MGREAD is not used and averages with no data are flagged by AVGFLG, set to 65536. Times having no data are flagged by FFLAG, also set to 65536. Data not needed for further averaging is flushed from the buffer and the remaining data repositioned.

2.2.3 Overlay (3,0) Plotting

This overlay extracts data from AVGEN and organizes it for plotting. The plotting request can be for any length of time, and for any number of stations. To allow for this flexibility, the routine may break a requested time period into several plots. Each plot is limited to MNP points, currently equal to 720. This may result in sampling the points rather than use all of them; in this routine, sampling rather than averaging is done.

This overlay and the next can be used interactively to examine sections of the data in as much detail as desired.

2.2.4 Overlay (4,0) Specialized Storage

This overlay transfers data between the standard file and a random access main storage file. When data is transferred from AVGEN, the two files do not have to agree in their parameters controlling the spacing of data points. Data from AVGEN, falling within the time interval and from the desired stations will be transferred to the position in MSFILE whose time is the closest. When a new AVGEN file is created, its time parameters are derived from those of MSFILE. To make the file AVGEN more compact, only data from the specified stations are used and only times having at least one valid piece of data are used.

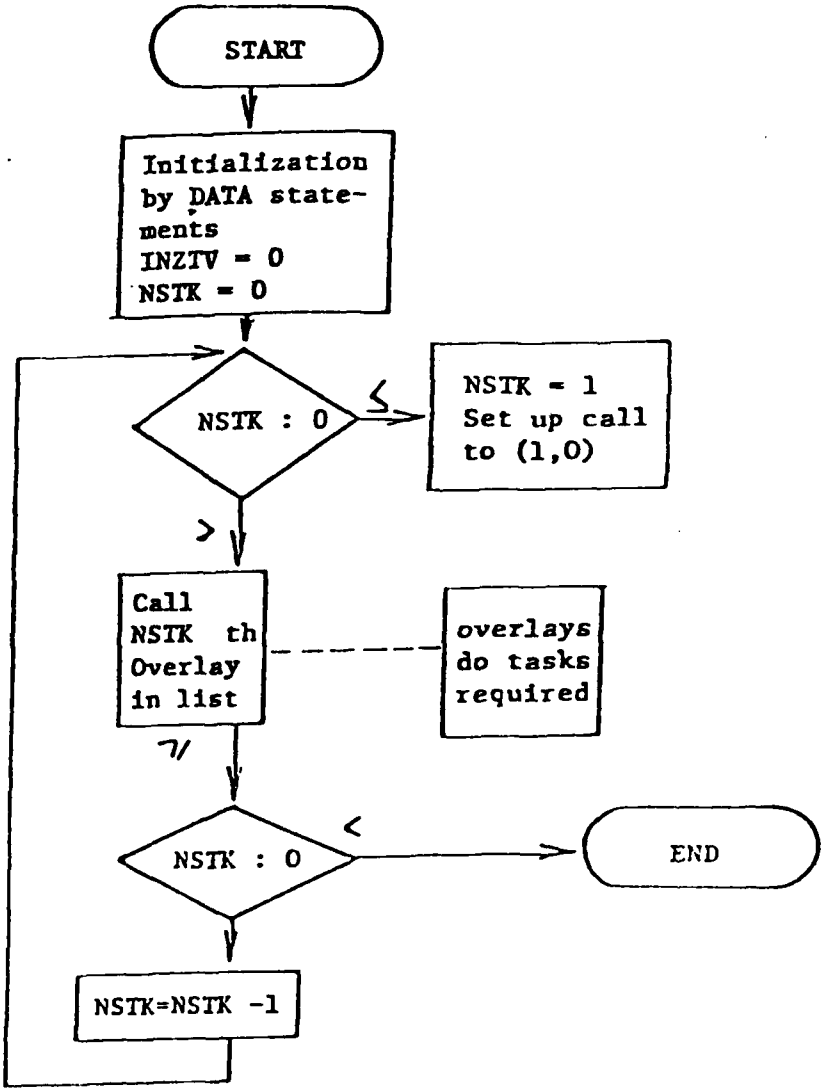

FIGURE 2.0

Overlay (0,0) Base Overlay

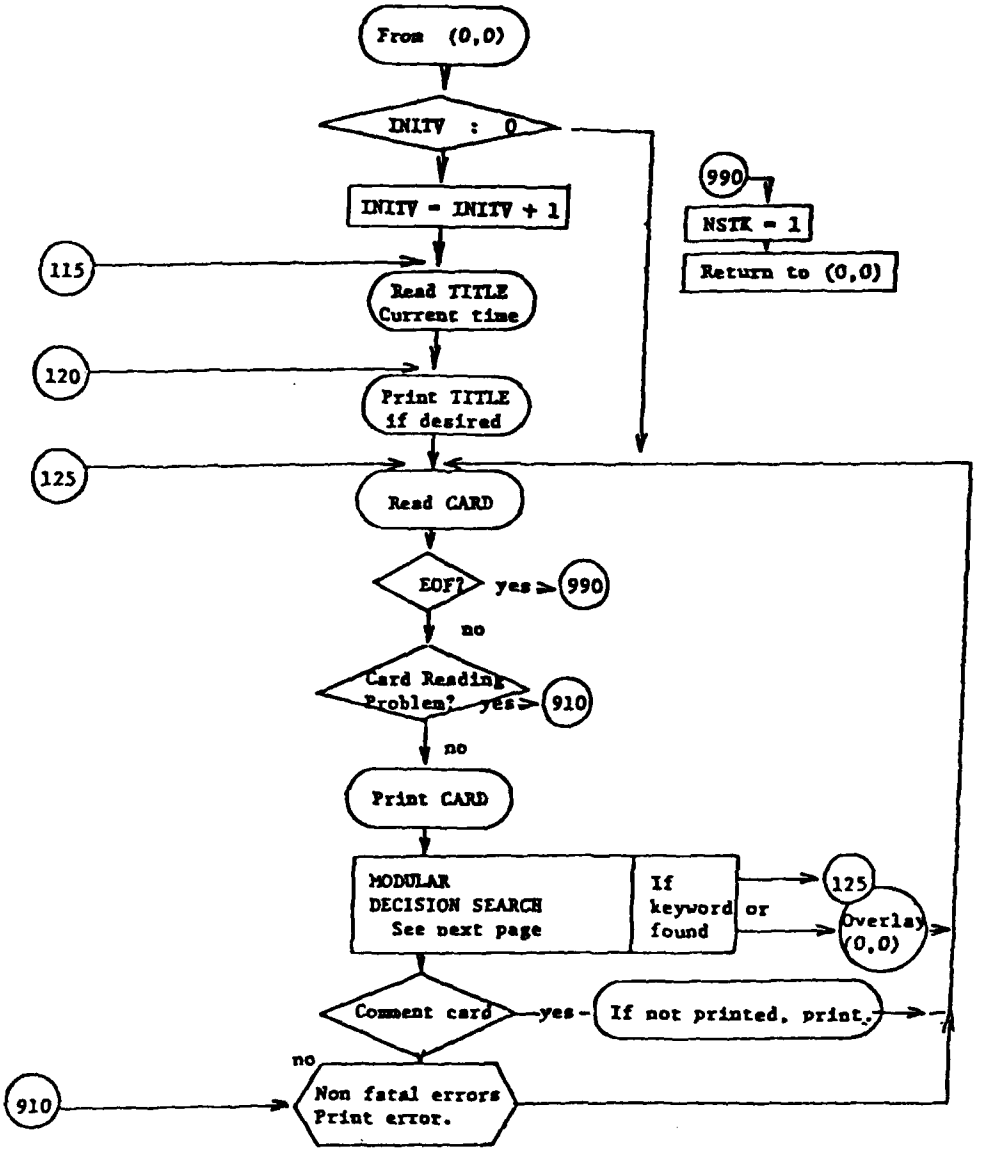

FIGURE 2.1

Overlay (1,0) Standard Modular Driver/controller

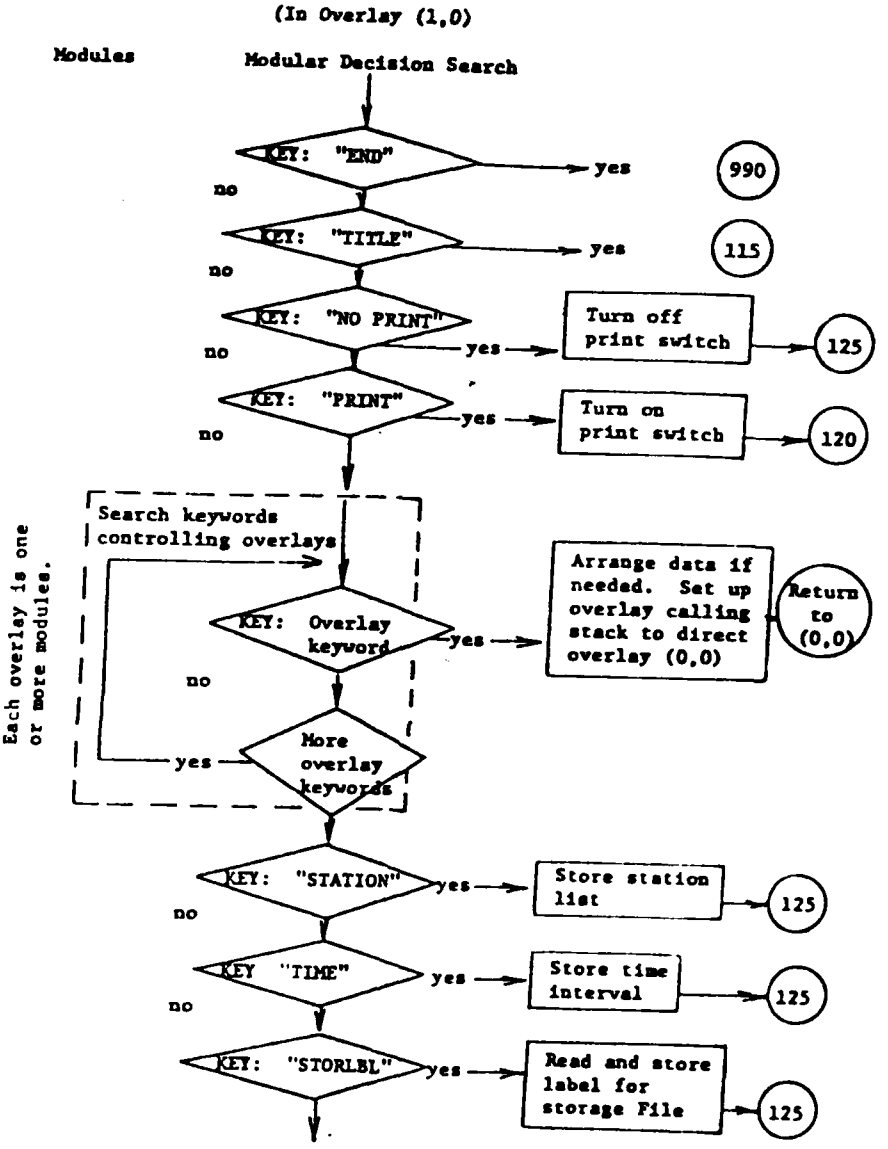
(In Overlay (1,0)
Modules
Modular Decision Search
KEY: "END"
yes
990
no
KEY: "TITLE"
yes
115
no
KEY: "NO PRINT"
yes
Turn off print switch
125
no
KEY: "PRINT"
yes
Turn on print switch
120
no
Search keywords controlling overlays
Each overlay is one or more modules.
KEY: Overlay keyword
yes
Arrange data if needed. Set up overlay calling stack to direct overlay (0,0)
Return to (0,0)
no
More overlay keywords
yes
KEY: "STATION"
yes
Store station list
125
no
KEY "TIME"
yes
Store time interval
125
no
KEY: "STORLBL"
yes
Read and store label for storage File
125

FIGURE 2.1.1

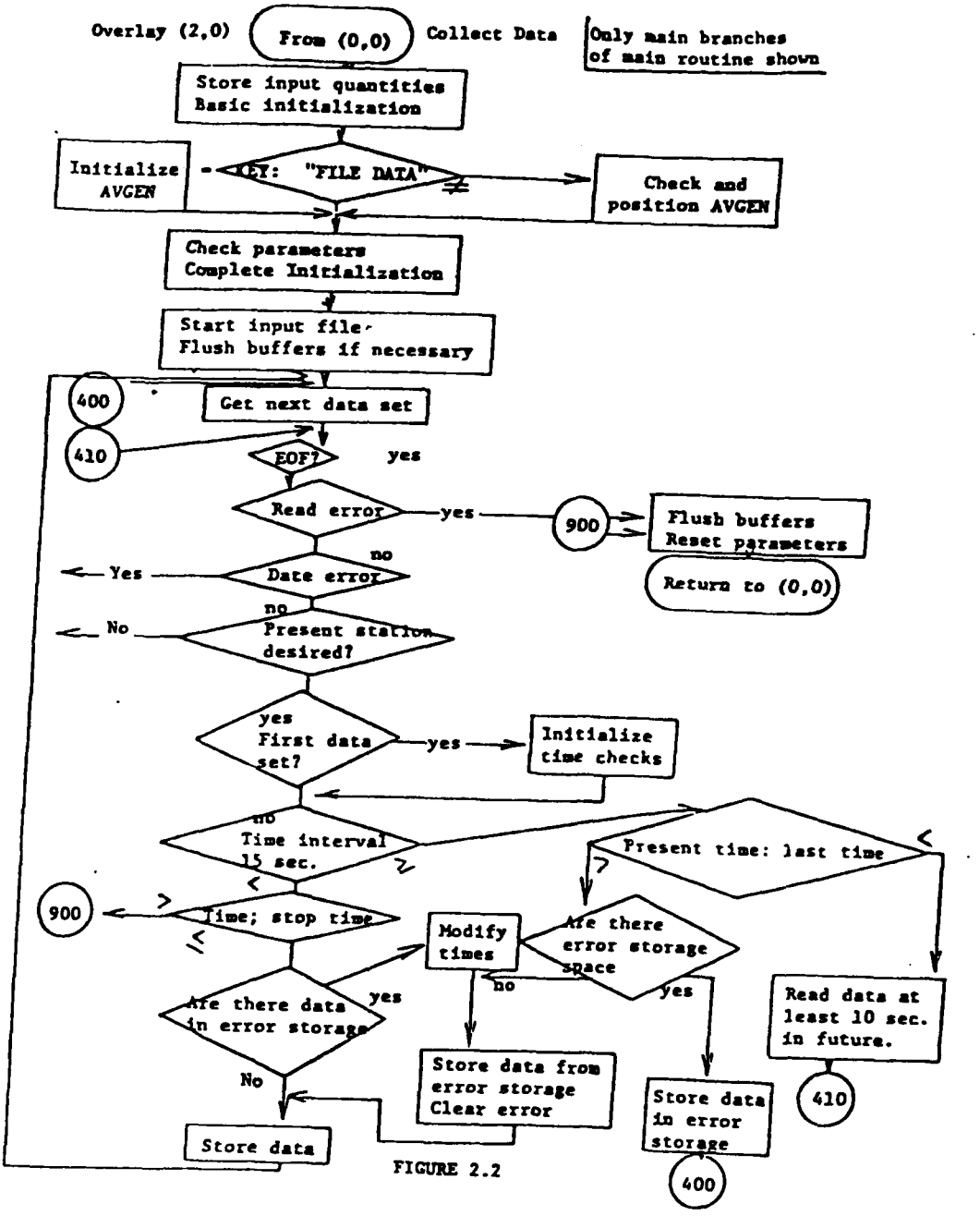
Overlay (2,0)
From (0,0)
Collect Data
Only main branches of main routine shown
Store input quantities
Basic initialization
Initialize AVGEN
KEY: "FILE DATA"
Check and position AVGEN
Check parameters
Complete Initialization
Start input file
Flush buffers if necessary
400
Get next data set
410
EOF?
yes
Read error
yes
900
Flush buffers
Reset parameters
Return to (0,0)
no
Yes
Date error
no
No
Present station desired?
yes
First data set?
yes
Initialize time checks
no
Time interval 15 sec.
Present time: last time
900
Time; stop time
Modify times
Are there error storage space
no
yes
Read data at least 10 sec. in future.
410
Are there data in error storage
yes
No
Store data from error storage
Clear error
Store data in error storage
400
Store data

FIGURE 2.2

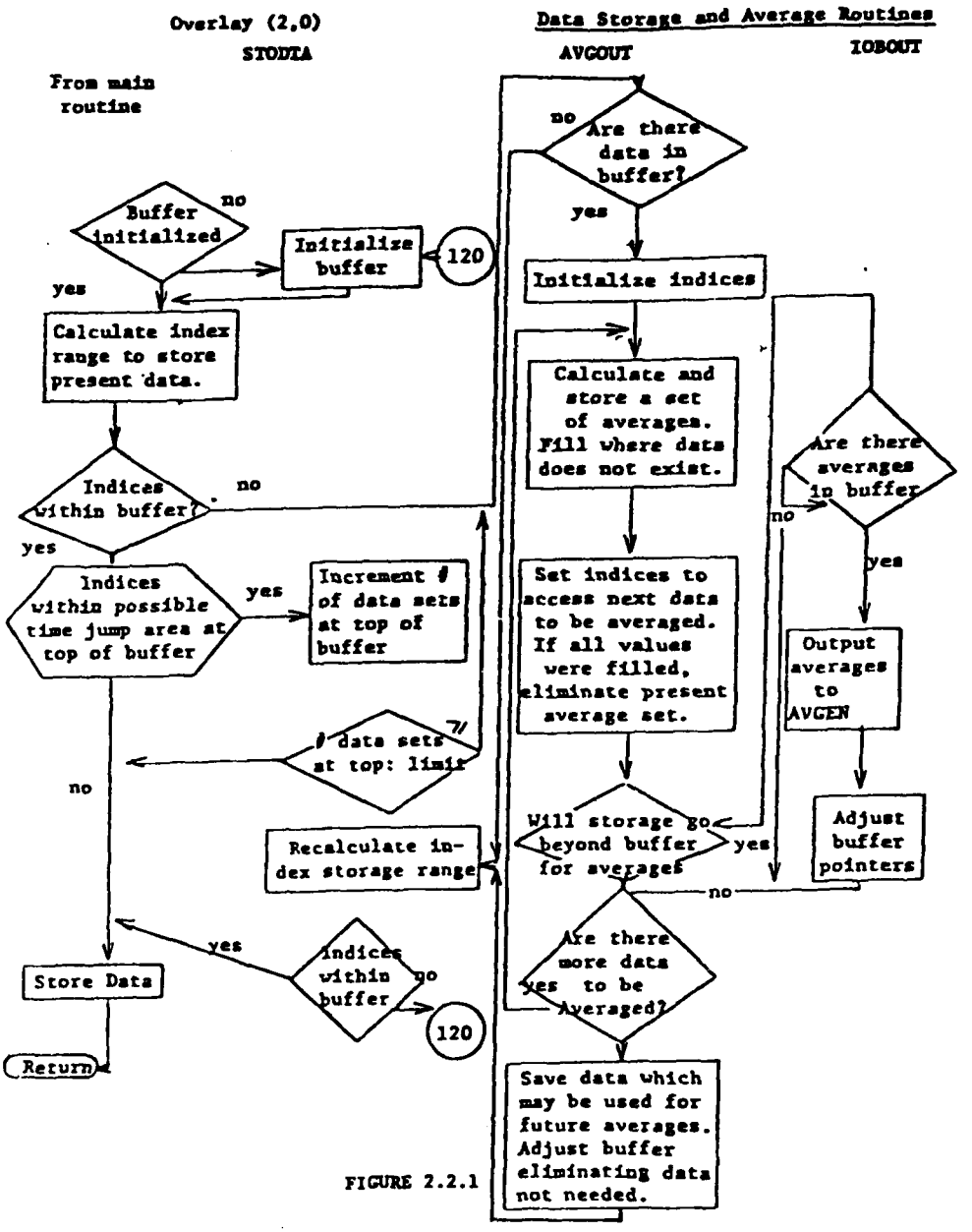
Overlay (2,0)
STODTA
Data Storage and Average Routines
AVGOUT
IOBOUT
From main routine
Buffer initialized
no
yes
Initialize buffer
120
Calculate index range to store present data.
Indices within buffer
no
yes
Indices within possible time jump area at top of buffer
yes
Increment # of data sets at top of buffer
data sets at top: limit
no
Recalculate index storage range
Store Data
Return
Indices within buffer
yes
no
120
Are there data in buffer?
no
yes
Initialize indices
Calculate and store a set of averages. Fill where data does not exist.
Set indices to access next data to be averaged. If all values were filled, eliminate present average set.
Will storage go beyond buffer for averages
yes
no
Are there more data to be Averaged?
yes
Save data which may be used for future averages. Adjust buffer eliminating data not needed.
Are there averages in buffer
no
yes
Output averages to AVGEN
Adjust buffer pointers

FIGURE 2.2.1

Overlay (3.0)

Plotting Overlay

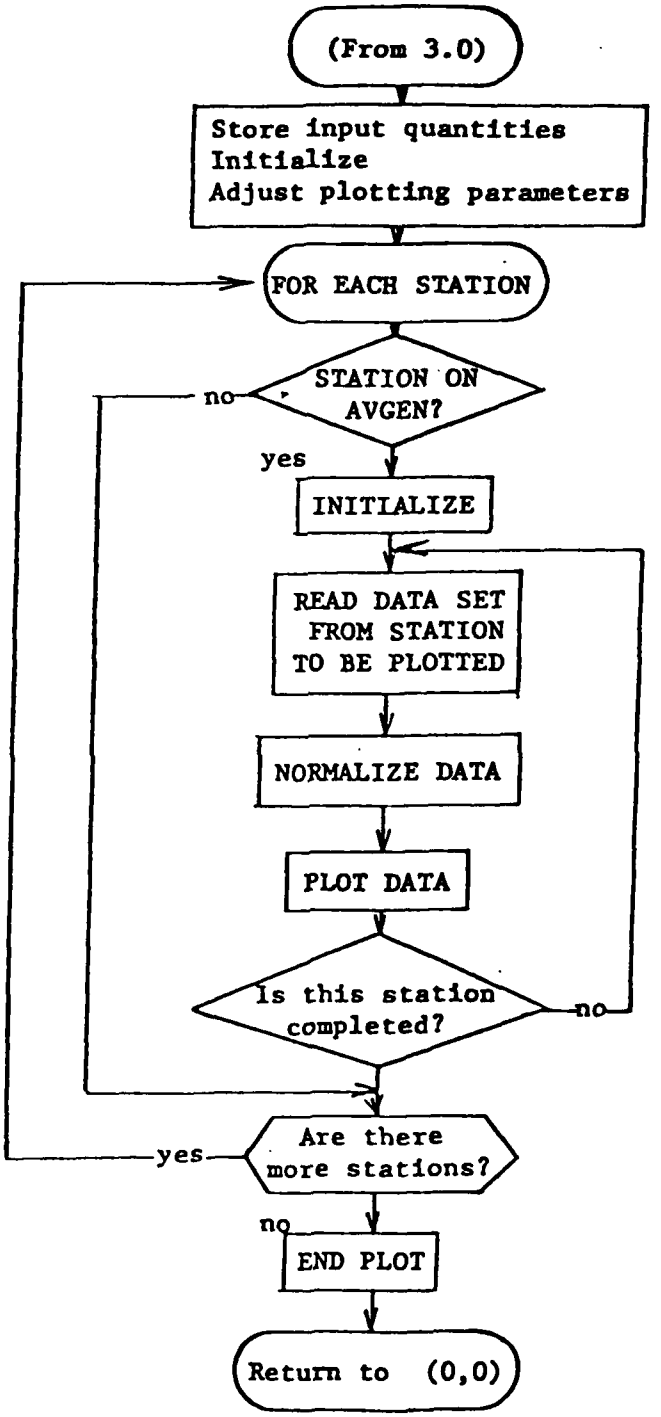

FIGURE 2.3

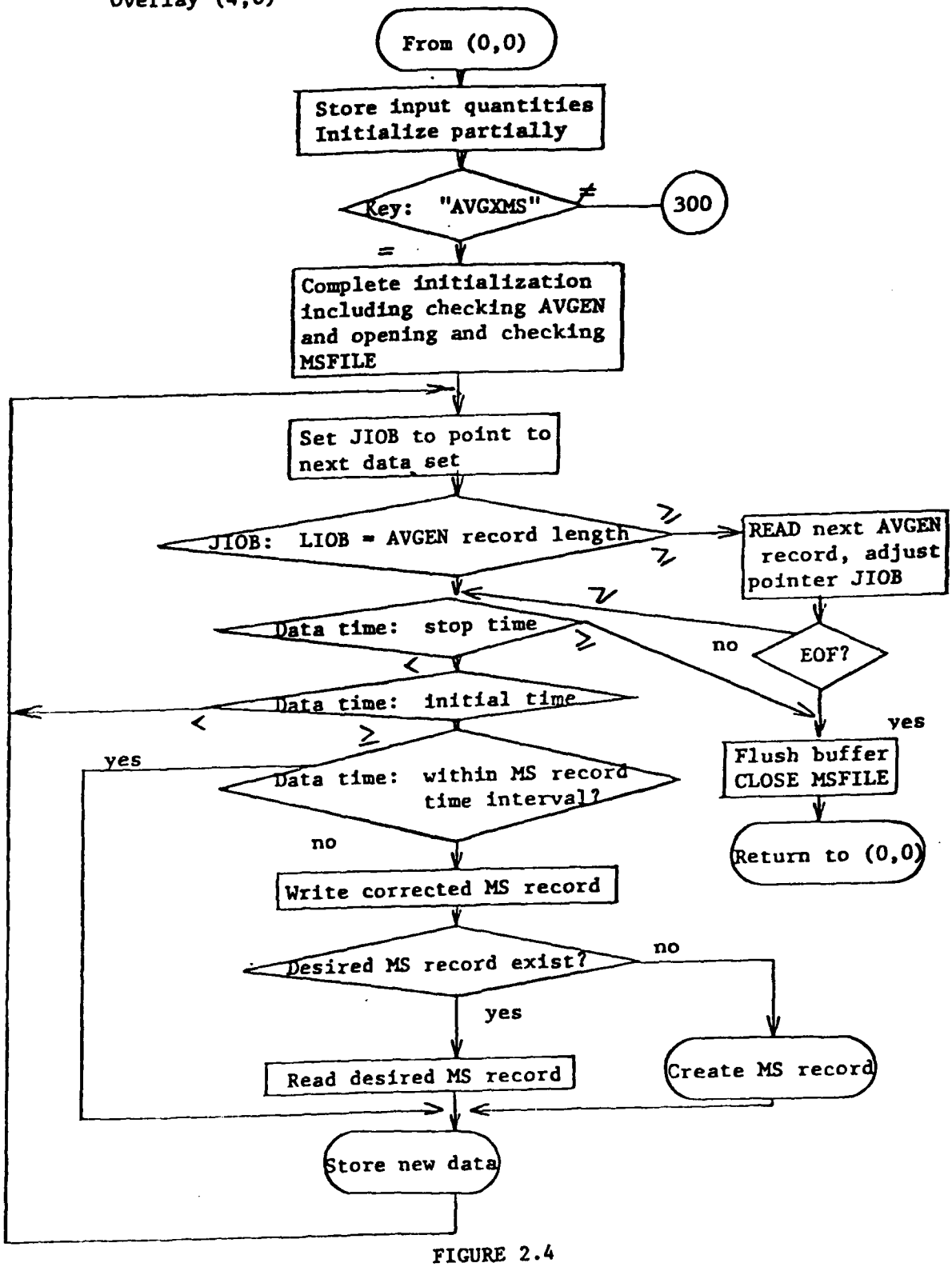
From (0,0)
Store input quantities
Initialize partially
Key: "AVGXMS"
≠
300
=
Complete initialization including checking AVGEN and opening and checking MSFILE
Set JIOB to point to next data set
JIOB: LIOB = AVGEN record length
≥
READ next AVGEN record, adjust pointer JIOB
<
Data time: stop time
≥
no
EOF?
yes
Data time: initial time
<
≥
yes
Data time: within MS record time interval?
Flush buffer
CLOSE MSFILE
Return to (0,0)
no
Write corrected MS record
Desired MS record exist?
no
yes
Read desired MS record
Create MS record
Store new data

FIGURE 2.4

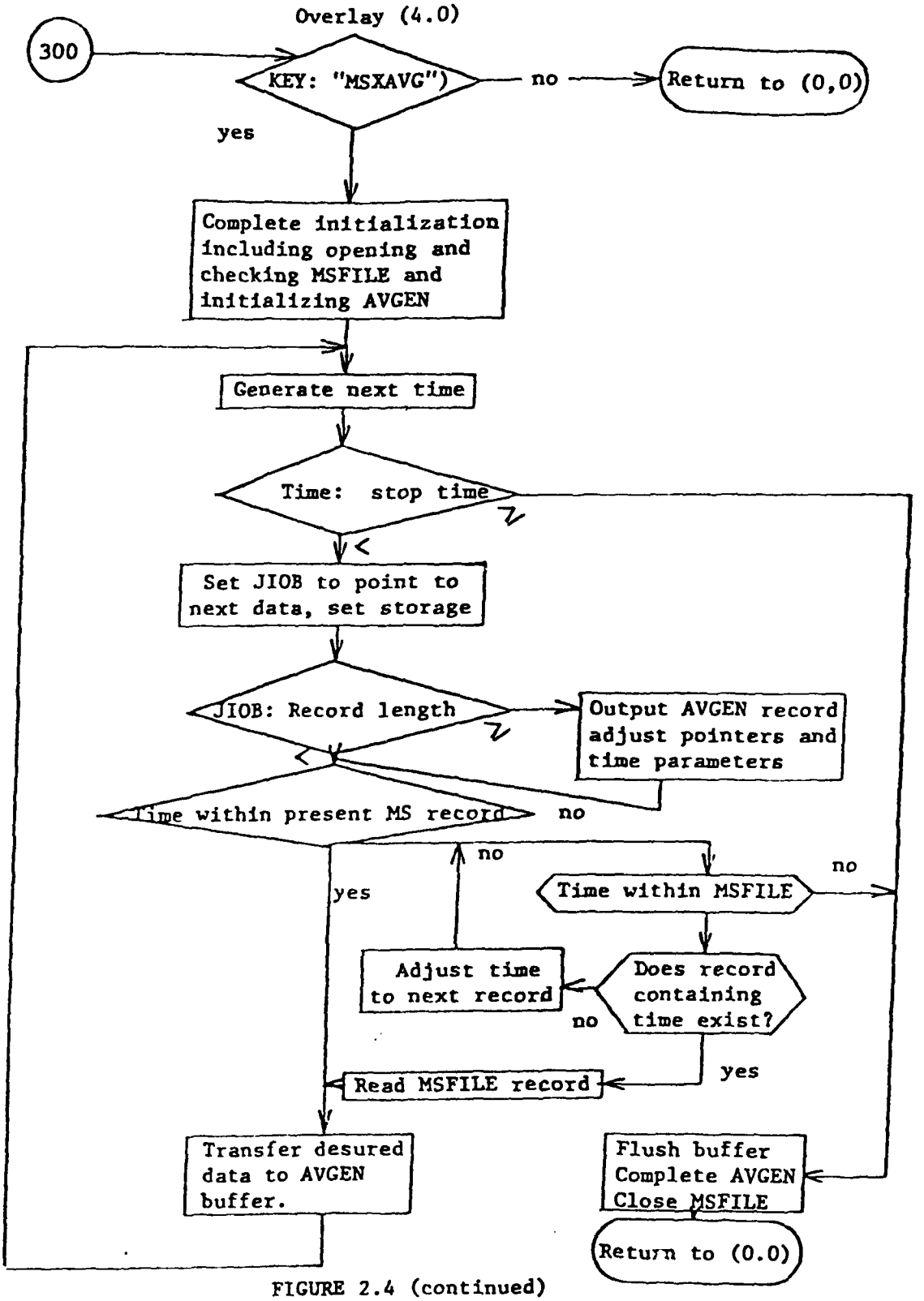

FIGURE 2.4 (continued)

3. Program Use

This program, MGOVL, is designed to be run either interactively or in batch mode. The program is structured such that the loader under the CDC NOSBE system will create a disk file with a local name MGOVL. This disk file can be made permanent. The program has been restricted to less than 600000 words of memory in order to be run interactively. The running time may be rather long, 650 sec, if entire tapes are processed. The usual tasks done interactively use much less time although it is desirable to raise the default interactive time limit.

A description of the input is given in section 3.1. The current options are listed in section 3.2.

3.1 Input Structure

The input described below is a free field input which is used for both batch and interactive use. A card in batch input is equivalent to a line in interactive use.

The first card read is saved as a title card and used to label the first page of output. The remaining cards are either keyword cards or cards which follow the keyword card requiring them. Each keyword causes values to be stored or an action to be performed. The main inter-dependence is the use by one keyword of values set by an earlier keyword. The program will stop upon reading an END card or an end of record.

The keyword cards are free field cards. The fields are separated by the break characters "," , "(", and "=". Leading and trailing blanks are ignored. Scanning ends when a termination character, either ")" or "." plus 20 blanks, or the end of the card is found.

A field with just digits and possibly a preceeding sign is treated as an integer. A real number occurs in a field with a point and/or an E preceeding an integer field. All other fields are alphanumeric and their first ten characters are used starting with the first non-blank. Blanks will not be removed from within the field but will be added to the end if necessary. After a termination character, the rest of the card can be used for comments. A null field, no non-blank character between two breaks or beyond the termination, usually results in defaults being used. The fields bracketing an "=" may form an equivalence pair. If the first field can be identified, the second field is used and both fields are removed from the card image. If the first field cannot be identified, "=" acts as a standard break character. If the value after the "=" is numeric, the program will convert it to the proper form. This is not true in general. The following are the current equivalence keys:

STA = concatinated list of standard indices for the stations to be processed. The default is all stations.

DEL = minutes between output data points or averages. The default is 1/6 minutes or 10 seconds.

ASEC = seconds to be averaged over. The default is 10 seconds.

If a keyword cannot be identified, an error message is printed and the next card is read. If the first column of the card contains a "C" and no keyword can be identified, it is assumed to be a comment card labelling the input.

3.2 Keyword Definitions

The present keywords and their fields are defined on the following pages. If the card is terminated before all fields are defined, those not defined will be treated as null fields. The keyword is given in upper case; the following fields in lower case.

The concatinated time used for many keywords is an integer in the form: YYDDDHHMMSS with YY, years since 1970; DDD, Julian day within year; HHMMSS, hours, minutes, and seconds within day.

TITLE	Reads next card as a new title.
NOPRINT	Stops printing of input cards.
PRINT	Starts printing of input cards. This is the default.
END	Stops execution. An end-of-record or end-of-file will also halt the program.
STATION	(Station index, station index, station index,...station index). Initializes station list based on standard indices; see Table 1.1. This function is also done by equivalence key "STA'; see section 3.1.
TIME	(Initial concatinated time, final concatinated time) Sets time parameter for processing).
STORLBL	Reads next card as a new title for AVGEN file. The default title is "MAGNETOMETER NETWORK DATA. FIRST RECORD CONTAINS PACKING AND AVERAGING DATA."
FILEDATA	(Initial time-concatinated, final time-concatinated) Initializes AVGEN and outputs data found on MGDATA between the times requested and from the stations requested and averaged as specified. See the equivalence keys in section 3.1.
ADDATA	(Initial time-concatinated, final time-concatinated) Positions AVGEN to allow averaged data to be transferred to it from MGDATA starting at the initial time. The status and averaging parameters are determined by those previously used for AVGEN.
PLOTLBL	Reads the first thrity columns of the next card to be the plot identifier. The default is "FOUGERE X3827 MAGNETOGRAM".
INTER	Causes the program to stop before and after each plot for interactive control.
NINTER	Causes the program to continue through the plots. This is the default.
SF	(Scale factor) Sets the plotting scale factor. If null, it is reset to default 1.5.
PORG (x,y)	Sets the plotting origin. The default is 0.5,0.5. A null value in either field leaves the former value unchanged.

A.1 Debug Disk File Structure and Use

The following sets of control cards set up a disk file containing a loadable binary file and an UPDATE file. In each set the cards referring to disk files must be changed from application to application and the cards defining and/or saving the I/O file sets must be added.

I. Debug Initialization

This set of cards reads in the Fortran or compass cards using UPDATE. An UPDATE file is created and the decks are compiled. If either causes an error the run is aborted. If compilation is successful, a binary file is created. These files are combined and put in a permanent disk file with the binary as the first file. An execution is then attempted.

```
-JOB CARD-
COMMENT. DEBUG  (AFGL/NOS)   -   INITIALIZATION
UPDATE(N,W,)
FTN (I=COMPILE, SL, T, R =3)
REWIND (LGO)
REQUEST (NL,*PF)
COPYBF(LGO,NL)
COPYBF(NEWPL,NL)
CATALOG(NL,MGOVLX,ID=                    )
ATTACH (PLTLIB,TEKLIB)
ATTACH (HTWLIB,ID=                       )
LIBRARY(HTWLIB,PLTLIB)
MAP(FULL)
LGO.
7/8/9
     UPDATE creation deck
7/8/9
     Program test data
7/8/9
6/7/8/9
```

II. Debug Testing

This set of cards compiles changes to UPDATE file and substitutes them using COPYL. This is for testing only and does not modify the disk file.

```
-JOB CARD-
COMMENT, DEBUG (AFGL/NOS)  -  TESTING
ATTACH (OL,MGOVLX, ID=            )
COPYBF(OL,BIN)
UPDATE (P=OL,R=C,Q)
FTN (I=COMPILE, SL, T, OPT=0,R=3)
REWIND(BIN;LGO)
COPY(BIN,LGO,B)
ATTACH(PLTLIB,TEKLIB)
ATTACH(HTWLIB,ID=                 )
LIBRARY(HTWLIB,PLTLIB)
B.
7/8/9
   UPDATE Modification deck
7/8/9
   Program test data.
```

III. Debug Update

This set of cards modifies the UPDATE FILE and compiles a new binary file. After cataloging the new disk file a run is attempted.

```
-JOB CARD-
COMMENT, DEBUG (AFGL/NOS  -  UPDATE
ATTACH (OL,MGOVLX ID=             )
SKIPF(OL,1,17)
UPDATE (N,P=OL,R=CN,W,F)
FTN(I=COMPILE,SL,T,R=3)
REWIND(LGO)
REQUEST(NL,*PF)
COPYBF(LGO,NL)
COPYBF(NEWPL,NL)
CATALOG(NL,MGOVLX,ID=             )
ATTACH(PLTLIB,TEKLIB)
ATTACH(HTWLIB,ID=                 )
LIBRARY(HTWLIB,PLTLIB)
MAP(FULL)
LGO.
7/8/9
   UPDATE modification deck.  (continued on next page)
```

```
7/8/9
   Program test deck.
7/8/9
5/7/8/9
```

IV. Production Run

This set of cards directly loads the program.

```
-JOB CARD-
ATTACH(OL,MGOVLX,ID=              )
ATTACH(PLTLIB,TEKLIB)
ATTACH(HTWLIB,ID=                 )
LIBRARY(HTWLIB,PLTLIB)
OL.
7/8/9
   Data Deck
7/8/9
6/7/8/9
```

V. Debug Audit

These control cardw ill list the binary decks in the binary file and the decks in the UPDATE FILE and will compile all decks to produce a listing. The list of binary decks includes the date of compilation, entry-point, and subroutines of each routine.

```
-JOB CARD-
COMMENT,   DEBUG   (AFGL/NOS)  -  AUDIT
ATTACH(OL,MGOVLX,ID=              )
DISPOSE(OUTPUT,*PR=C)
SKIPF(OL,1,17)
UPDATE(P=OL,R=C,F,L=F)
FIN(I=COMPILE,SL,T,R=3)
REWIND(OL)
ATTACH(PLTLIB,TEKLIB)
ATTACH(HTWLIB,ID =                )
LIBRARY(HTWLIB,PLTLIB)
MAP(FULL)
LOAD(OL)
NOGO.
6/7/8/9
```

A.2 Special Programs

Threee routines were developed to aid in checking the files. The first is currently useful in checking data problems while the latter two routines are useful in checking the contents of the files.

DUMPMG prints records from the archive tapes. The data is printed on octal just as it is received by the CDC 6600 and must be interpreted manually. This allows data problem areas to be checked in detail.

PFPRNT prints the contents of the file AVGEN. The number of CDC words in each record is given. The label and access data records are listed. For each data record, the times and corresponding data are listed in tabular form. The time is given in the concatinated form as well as milliseconds since Jan. 0, 1970.

DMPMS prints a summary of the data in the file MSFILE. The label record is listed. For each record containing data, the range of times covered by that record are listed. The data itself is not checked so that gaps within the time intervals are not noted.

Further development might include the incorporation of these routines into MGOVL and expanding their capabilities. It would be helpful if AVGEN and MSFILE could be scanned in detail, within particular times or in total, and all data gaps larger than a particular value be reported for all stations or for selected ones.

/OVERLAY/	Defines KEYWORD - Overlay Relation
NOVL 10	Number of overlays
MOVL 16	Max. number of overlays
NDOVL 5	First dimension of KOVL
KOVL (5,16)	Keyword overlay array, 1st index
/SOVRLY/	Sequential Overlay Link
KSTK 0	Index for KSTK for next overlay after decriment
MSTK 8	Max. number overlay links
NSTK (8)	Overlay link stack
/INITOV/	Initialization Switch
INITV 0	First card is read as title if INITV is 0
/IO/	I/O Common
IN	Input file
IOUT	Output file
/IOX/	I/O Extra Files
IOLD	Old AVGEN to be copied from
IAG	General average data file
MSF	Mass storage file
/MGDATC/	Data Input File
MGDATA 6LMGDATA	Magnetometer Archive Data Tape
/KEY/	Keyword common
NZ	Number of items
MZ 12	Max. number of items
KEY	Keyword
IZ (11)	Other items from card
KKEY	Keyword key
K7 (11)	Keys indicating formats used for interpreting IZ
/EQUIV/	Equivalence Common
NEQ 3	Number of defined parameters
MEQ 8	Max. number of parameters
IEQ(8) 0	Values obtained from card
NKQ(2,8)	Symbol definition/expected key

TABLE 2.2.0C COMMONS IN BASE OVERLAY

	STA numerical (real) Station string DEL numerical (real) Output data step ASEC numerical (integer) Number seconds average
/CARD/	Keyword card common
MCARD 80	Number of columns used
KARD(80)	Card characters
/TITLEC/	Run Title Common
DATE(2)	Date and time when title was read
TITLE(8)	Title from title card
/PRTST/	Print Switch
PRTEST	Printing to be done?
/STLBLC/	Storage Label Common
STLBL(8)	Label for data set
/TIMEC/	Title Common (*means initialized by MSTIME)
INTC 0	Initial time concatinated
INTDAY *	Days since 0 Jan. 1970
INTIME *	Milliseconds in day
INTMS *	Milliseconds since 0 Jan. 1970
LSTC	Last time concatinated
LSTDAY *	Days since 0 Jan. 1970
LSTIME *	Milliseconds in day
LSTMS *	Milliseconds since 0 Jan. 1970
/STATC/	Station Common (*means initialized by STATNS D means initialzed by data statement)
ND 3	Number of data/quantities/station/time point
NQT	Number of quantities in time point
KSTA	Station sequence number
JSTA	Data station number
NSTA	Number of stations
MSTA 10	Max. number of stations
LBLOST(10) D	Label external index

IDOST(10)	D	Data index (external index)
LBLDST(10)		Label (data index)
IODST(10)	1	External index (data index)
ISOST(10)	*	Storage index (external index)
ISDST(10)	*	Storage index (data index)
IDLSST(10)	*	Label (storage index)
IOSST(10)		External index (storage index)
IDSST(10)		Data index (storage index)
/LIOBUF/		Length of Arrays Stored in AVGEN
LIOAVG	69	Length of /AVGC/
LIOST	96	Length of /STATC/
/PLOTC/		Plot Parameters
IPLOT	-1	Type of plot
MMM	0	Plot Parameter
MAX	1	Plot Parameter
NP	720	Number of points plotted
START		Start time
PLOTIM	24	Plot time (hr)
MSPLOT		Plot time (ms)
DEL	2.	Point spacing (min)
MSDEL		Point spacing (ms)
DELTIC	2.	Time between tics (hr)
/PLTLBL/		Label for Plot
PLOTID(3)		Label set by data statement
/SF/		CRT Plot Initialization Parameter
SF	1.5	Plotting scale factor
XP	.5	X - plotting frame value
YP	.5	Y - plotting frame value
/INTERC/		Common for Interactive Use Parameters
KINTER	0	If non-zero, adjust for interactive operation.

/DATAK/		Buffer to Handle Data Quantities
NDATA	30	Length of data
DATA(30)		Data buffer
/OOPSC/		Buffer for problem data
MSOK	1500	Acceptable millisecond change interval
NDOOPS		Storage needed for one data set plot information
IOOPS		Next error index to be used
LOOPS	96	Error buffer length
KOOPS(96)		Error buffer
/BUFX/		Quantities Defining Buffer Status
MSBASE	-1	First time in buffer (ms), used to calculate index
MSPT	1000	Milliseconds/time point
MSSET		Milliseconds/data set
MPSET	10	Number of time points/data set
NQS	3	Number of data quantities/station point
NQST		Number of quantities/output set
NQSET		Number of quantities/input set
/FFG/		Error Flags
FFLAG	65536.	Fill flag when there is no data
XFLAG	32768	Data greater than this value not used
AVGFLAG	65536.	Value used if there are no points in average
/AVGC/		Quantities Defining Averaging
NMSAVG	=MSTP*NTAVG	Milliseconds averaged over
NTAVG	10	Time points averaged over
MSDAVG	=MSTP*NTDAVG	Millisecond shift between averages
NTDAVG	10	Time point shift between averages
LAVBUF	=NQST*NTAVG	Storage needed for one set of averages
IDAVBF	=NQST*NTDAVG	Index range for one set of averages
MN		Min index for quantities being averaged
MX		Max index for quantities being averaged
NS2	60	Composite dimension of S and XN
S(30)		Sums
XN(30)		Number of items in each sum

TABLE 2.2.2C ADDITIONAL COMMONS IN OVERLAY (2.2)

/MGDIMF/		See MGREAD for explanation. NREC set to 0 for proper restart
//		Large buffers
IOB(512)		Final output buffer
IBUF(7680)		Buffer to hold data before averaging
/IOBUFK/		Quantities Defining Buffers
JIOB		IOB storage index
LIOB	512	IOB length
ISX		IBUF storage index
LBUF	7680	IBUF length
LIMISX		IBUF storage limit causing averaging when crossed by initial item of a set
NISX	=0	Number of times ISX crossed LIMISX
MISX	5	Max. number of times LIMISX may be crossed before mandatory flushing of buffer.
/BMBFIL/		Data to be Printed at Bombout
LMS		Last time processed in milliseconds

CONSTANTS

IDT	34	Data type wanted from MGREAD
MSMDIF	200000000	Max. forward time jump processed in milliseconds.

//		Plotting Arrays
HDZGAM	(720,3)	Components of magnetic field at different times
XTIME	(720)	Corresponding times
DYGAM	(3,7)	Half-range sizes
BSLV	(3,7)	Mid-range values
/FFC/		Error Flags (Same as in overlay (2,0)
FFLAG	65536.	Fill flag when there is no data
XFLAG	32768.	Data greater than this value is not used
AVGFLAG	65536.	Value used if there are no points in average
/AVGC/		Quantities Defining Averaging (As in overlay (2,0)
NMSAVG		Milliseconds averaged over
NTAVG	10	Time points averaged over
MSDAVG		Millisecond shift between averages
NTDAVG	10	Time point shift between averages
LAVBUF		Storage needed for one set of averages
IDAVBF		Index range for one set of averages
MN		Min. index for quantities being averaged
MX		Max. index for quantities being averaged
NS2	60	Composite dimension of S and XN
S(30)		Sums
XN(30)		Number of items in each sum
/PLOTMS/		Plot Times Common
INPC		Initial time, concatinated, from data set of card
INPDAY		, day
INPTIM		, ms within day
INPMSM		, ms since 0 Jan., 1970
LSPC		Last time, concatinated, from MSXTRA of card
LSFDAY		, day
LSPTIM		, ms within day
LSPMSM		, ms since 0 Jan., 1970
JPTC		Ongoing plot time, concatinated
JPTDAY		, day
JPTIME		, ms within day
JPTMS		, ms since 0 Jan., 1970

TABLE 2.2.3C ADDITIONAL COMMONS IN OVERLAY (3,0)

/PLTERR/		Error Check Common
PLTXIN	65536.	Defines errors
PLTXOU	99999.	Value used for errors
/INBUFC/		Input Buffer Common
MIOB	512	Buffer size
IOB(512)		Buffer
/AGLBLC/		Avgen Label Common
LAGLBL	20	Length
IAGLBL(20)		Label
/RED3WC/		Lindage Needed for Restart
MVIRG		

/FFC/		Error Flags (same as in overlay (2,0)
FFLAG	65536.	Fill Flag when there is no data
XFLAG	32768.	Data greater than this value not used
AVGFLAG	65536.	Value used if there are no points in average
/AVGC/		Quantities defining averaging (as in overlay (2,0)
NMSAVG		Milliseconds averaged over
NTAVG	10	Time points averaged over
MSDAVG		Millisecond shift between averages
NTDAVG	10	Time point shift between averages
LAVBUF		Storage needed for one set of averages
IDAVBF		Index range for one set of averages
MN		Min index for quantities being averaged
MX		Max index for quantities being averaged
NS2	60	Composite dimension of S and XN
S(30)		Sums
XN(30)		Number of items in each sum
/RAMSX/		Parameters Defining Random Mass Storage
INTCM		Initial time concatinated
INTMSM		Initial time milliseconds
LSTCM		Final time concatinated
LSTMSM		Final time milliseconds
NSDM (3)		Data items per stations
NSTAM (7)		Number of stations
IMOST		Conversion of standard index to mass storage index
NOSETM (21)		Number of quantities per time set
NTREC	180	Number of time sets per record
MSDMS	120000	Milliseconds per time set
MSREC		Milliseconds per record
LRECMS (3780)		Length of mass storage record file
LRAMSX	44	Length of saved common
LRECMS (3781)		Length of mass storage record
FILLMS	65536.	Fill value

TABLE 2.2.4C ADDITIONAL COMMONS IN OVERLAY (4,0)

SEARCH	Searches for proper keyword.
NOW	Obtains date and time in characters.
KREAL	Creates real and integer numbers from input character string.
PRTITL	Prints title, time, and page numbers.
IEQUIV	Scans input for equal signs and substitutes.
NUMCVT	Converts between real and integer if necessary.
KEYWRD	Reads and interprets free field input.
HOLLER	Creates Hollerith "values" from input character string.

TABLE 2.2.1R ROUTINES IN OVERLAY (1,0)

FILDTA	Extracts data from data base and stores it.
MSTOTAL	Converts time to milliseconds.
MGREAD	Extracts desired data.
ISEARCH	Positions data base.
ADDFLUX	Combines flux data which is stored separately in base.
MOVEIT	Adjusts data in double buffers.
MGUNPK	Unpacks packed data.
ISLOTER	Finds next data set.
ITISUM	Extracts time from data.
CHECK	Checks data error flags.
TIMSTOP	Adjusts time parameters to handle time skips.
STODTA	Stores desired data in buffer.
AVGOUT	Averages data, stores average.
IOBOUT	Outputs averaged data and adjusts buffer.
BMBOUT	Is called if system terminates program.
IFCLC8	Finds I/O file list.
NOW	Obtains date and time in characters.

TABLE 2.2.2R ROUTINES IN OVERLAY (2,0)

MGOVL	Main routine, calls overlays.
STATNS	Initializes station index tables.
MSTIME	Converts concatinated time to milliseconds.
ICTIME	Converts milliseconds to concatinated time.
MOVE	Efficiently moves blocks of data.
INTGRS	Separates number into digits.
IORDR2	Orders a list and adjusts associated list.

TABLE 2.2.OR ROUTINES IN BASE OVERLAY

```
//                  Buffers
IOB (512)           Avgen buffers
MSX (1536)          Msfile index
MSB (4096)          Msfile buffer
/MSBUFK/            Buffer access parameters
LIOB                Current length of avgen buffer
LMSX                Current length of msfile index
LMSB                Current length of msfile buffer
JIOB                Current index of avgen buffer
JMSX                Current index of amsfile index
JMSB                Current index of amsfile buffer
/MSLBLK/            Initial label for msfile
MSLBL (10)          Initial label for msfile
```

SPECGRM	Controls plotting of data from AVGEN.
IRED3W	Extracts data to be plotted.
BASE	Scans data and sets normalization parameters.
MSPLOT	Plots three magnetic quantities.
AAXIS	Writes axis numbers
DAMOYR	Labels plot from concatinated time.
LINER	Plots data.

TABLE 2.2.3R ROUTINES IN OVERLAY (3,0)

FILCVT	Converts data between files.
INITMS	Initializes mass storage file, MSFILE.
INITAG	Initializes AVGEN.
NOW	Obtains date and time in characters.

TABLE 2.2.4R ROUTINES IN OVERLAY (4,0)